

CLAIMS

- 1 1. A medical device for use in a mammal comprising:
2 (a) a bioresorbable bulk material; and
3 (b) resorbable particles embedded in said bioresorbable bulk material, said resorbable particles
4 causing said bioresorbable bulk material to resorb upon contact with a body fluid at a
5 controllable resorption rate.
6
- 1 2. The medical device of claim 1 wherein said resorbable particles resorb upon contact with
2 a body fluid at a resorption rate that is different from the resorption rate of said bioresorbable
3 bulk material.
4
- 1 3. The medical device of claim 2 wherein the resorption rate of said resorbable particles is
2 greater than the resorption rate of said bioresorbable bulk material.
3
- 1 4. The medical device of claim 1 wherein said bioresorbable bulk material comprises an
2 ionically crosslinked polymeric material.
3
- 1 5. The medical device of claim 1 wherein said bioresorbable bulk material comprises a
2 covalently crosslinked polymeric material.
3
- 1 6. The medical device of claim 4 wherein said ionically crosslinked polymeric material
2 comprises at least one polymer or copolymer made from at least one member of the group
3 consisting of polyacrylic acids, polymethacrylic acid, polyethylene amine, polysaccharides,
4 alginic acid, pectinic acids, carboxy methyl cellulose, hyaluronic acid, heparin, chitosan,
5 carboxymethyl chitosan, carboxymethyl starch, carboxymethyl dextran, heparin sulfate,
6 chondroitin sulfate, cationic starch, and salts thereof.
7

1 7. The medical device of claim 4 wherein said ionically crosslinked polymeric material is an
2 ionically crosslinked polymer hydrogel and has a water content of less than 90% by weight and
3 possesses sufficient mechanical strength to serve as a stent, a catheter, a cannula, a plug, a
4 constrictor, a sheet, a filler, a bone anchor, a plate, a rod, a seed, a tube, or a portion thereof.
5

1 8. The medical device of claim 1 wherein said medical device is a stent, a catheter, a
2 cannula, a plug, a constrictor, a sheet, a filler, a bone anchor, a plate, a rod, a seed, a tube, or a
3 portion thereof.
4

1 9. The medical device of claim 1 wherein each of said resorbable particles comprises an
2 organic compound.
3

1 10. The medical device of claim 1 wherein each of said resorbable particles comprises a
2 soluble or degradable inorganic compound.
3

1 11. The medical device of claim 9 wherein said organic compound is a sugar or a water
2 soluble organic salt.
3

1 12. The medical device of claim 1 wherein each of said resorbable particles comprises an
2 organic or inorganic crystal or powder aggregate.
3

1 13. The medical device of claim 1 wherein each of said resorbable particles comprises a
2 water-swellaable polymer.
3

1 14. The medical device of claim 13 wherein said water-swellaable polymer comprises a
2 material selected from the group consisting of polysaccharides, polyglycolic acid, polylactic acid,
3 cellulose derivatives, hyaluronic acid, and colloid/hydrogel.
4

1 15. The medical device of claim 1 wherein the size of each of said resorbable particles is
2 from about 5 nm to about 1 mm.

3
1 16. The medical device of claim 1 wherein the ratio of said resorbable particles in said
2 bioresorbable bulk material is equal to or less than about 50 % by volume.
3

1 17. The medical device of claim 1 wherein each of said resorbable particles comprises a
2 polymer selected from the group consisting of polysaccharides, polyglycolic acid, polylactic acid,
3 and polycaprolactone and copolymers of any two or three of glycolic acid, lactic acid, and
4 caprolactone monomers.
5

1 18. A medical device for use in a mammal comprising:

2 (a) a bioresorbable bulk material; and

3 (b) particles embedded in said bioresorbable bulk material, said particles comprising a magnetic,
4 paramagnetic, or superparamagnetic material and causing said bioresorbable bulk material to
5 resorb upon contact with a body fluid at a controllable resorption rate.
6

1 19. The medical device of claim 18 wherein said controllable resorption rate of said
2 bioresorbable bulk material is faster than a resorption rate of said bioresorbable bulk material
3 without said embedded particles.
4

1 20. The medical device of claim 19 wherein the size of each of said particles is from about 5
2 nm to about 1 mm.
3

1 21. The medical device of claim 19 wherein the volume percentage of said resorbable
2 particles in said bioresorbable bulk material is equal to or less than about 50 %.
3

1 22. A method for controlling resorption of a bioresorbable material in a device for use in a
2 mammal, said method comprising:

3 (a) providing a bioresorbable bulk material;

4 (b) embedding resorbable particles in said bioresorbable bulk material, said resorbable particles
5 resorb faster upon contact with a body fluid than said bioresorbable bulk material; and

6 (c) contacting a body fluid with said bioresorbable bulk material and said resorbable particles
7 thereby causing said bioresorbable bulk material to resorb at a controllable resorption rate.
8

1 23. The method of claim 22 wherein said controllable resorption rate is different from the
2 resorption rate of said bioresorbable bulk material without said embedded resorbable particles.
3

1 24. The method of claim 23 wherein said bioresorbable bulk material comprises an ionically
2 crosslinked polymeric material.
3

1 25. The method of claim 23 wherein said bioresorbable bulk material comprises a covalently
2 crosslinked polymeric material.
3

1 26. The method of claim 23 wherein said resorption rate is controlled by varying the size or
2 the amount of said resorbable particles.
3

1 27. The method of claim 23 wherein said resorbable particles swell upon contact with said
2 body fluid.
3

1 28. The method of claim 23 wherein said resorbable particles hydrolyze into by-products
2 soluble in said body fluid upon contact with said body fluid.
3

1 29. A method for controlling resorption of a bioresorbable material in a device, said method
2 comprising:

3 (a) providing a bioresorbable bulk material;

4 (b) embedding particles having a pre-selected magnetic property in said bioresorbable bulk
5 material;

6 (c) providing a magnetic field surrounding said particles; and

7 (d) inducing activation or vibration of each of said particles thereby causing said bioresorbable
8 bulk material to resorb at a controllable resorption rate.
9

1 30. The method of claim 29 wherein said controllable resorption rate is different from a
2 resorption rate of said bioresorbable bulk material without said embedded particles.
3

1 31. The method of claim 30 wherein each of said particles is magnetic, paramagnetic, or
2 superparamagnetic and wherein said inducing activation or vibration of each of said particles is
3 by varying said magnetic field surrounding said particles.
4

1 32. A method for controlling resorption of a medical device, said method comprising
2 (a) providing a bioresorbable bulk material shaped as a medical device;
3 (b) providing a coating material comprising a dissolvable polymeric material that allows
4 diffusion of a body fluid through said coating material at a controllable rate; and
5 (c) coating said medical device with said coating material.
6

1 33. A composition for use in a device in a mammal, said composition comprising:
2 (a) a bioresorbable bulk material; and
3 (b) resorbable particles embedded in said bioresorbable bulk material, said resorbable particles
4 causing said bioresorbable bulk material to resorb upon contact with a body fluid at a
5 controllable resorption rate.
6

1 34. A composition for use in a device in a mammal, said composition comprising:
2 (a) a bioresorbable bulk material; and
3 (b) resorbable particles embedded in said bioresorbable bulk material, said resorbable particles
4 having a resorption rate that is different from a resorption rate of said bioresorbable bulk material
5 and said resorbable particles causing said bioresorbable bulk material to resorb at a controllable
6 rate upon contact with a body fluid.
7

1 35. The composition of claim 34 wherein the resorption rate of said resorbable particles is
2 greater than the resorption rate of said bioresorbable bulk material.
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1 36. The composition of claim 34 wherein said bioresorbable bulk material comprises an
2 ionically crosslinked polymeric material or a covalently crosslinked polymeric material.
3

1 37. The composition of claim 34 wherein each of said resorbable particles comprise an
2 organic compound.
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1 38. The composition of claim 34 wherein each of said resorbable particles comprise a soluble
2 or degradable inorganic compound.
3

1 39. The composition of claim 34 wherein each of said resorbable particles comprise organic
2 or inorganic crystals or powder aggregates.
3

1 40. The composition of claim 34 wherein each of said resorbable particles comprise a
2 polymer.
3

1 41. The composition of claim 34 wherein the size of said resorbable particles is about 5 nm to
2 about 1 mm.
3

1 42. The composition of claim 34 wherein the volume percentage of said resorbable particles
2 in said bulk material is equal to or less than about 50 %.
3

1 43. The composition of claim 34 wherein each of said resorbable particles comprise a
2 magnetic, paramagnetic, or superparamagnetic material.
3

1 44. A system for controlled delivery of a pharmaceutical agent in the body of a mammal, said
2 system comprising a carrier device having coated thereon a bioresorbable ionically or covalently
3 crosslinked polymeric material and incorporated therein said pharmaceutical agent.
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1 45. A coating material for use in a medical device for regulating resorption of said medical
2 device, said coating material comprises a bioresorbable ionically or covalently crosslinked

- 3 polymeric material that allows diffusion into said medical device by a body fluid at a pre-selected
- 4 rate.